

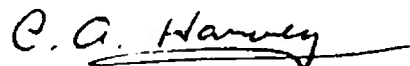
LOW LEVEL WHITE LIGHTING:
FURTHER EVALUATION AT SEA

by

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Memo Report 86-3

Approved and Released by:

A handwritten signature in cursive script, reading "C. A. Harvey", with a horizontal line drawn underneath the name.

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SUMMARY PAGE

THE PROBLEM

To further evaluate LLW lighting as a replacement for the red lighting in the control and radio rooms.

THE FINDINGS

The officers and men in the control and radio rooms of the USS AUGUSTA (SSN 710) rated the LLW favorably as a replacement for the existing red light. Few problems were noted by the watchstanders or the periscope operators.

APPLICATIONS

The use of LLW lighting in the control spaces is recommended. LLW lighting will provide a better lighting environment now and with the future use of color displays.

ADMINISTRATIVE INFORMATION

This investigation was conducted under Naval Medical Research and Development Command Research Work Unit M0100.001-1023 -- "Enhanced visual performance on submarines". The manuscript was submitted for review on 6 June, approved for publication on 13 June 1986 and it has been designated as NSMRL Memorandum Report 86-3.

ABSTRACT

Twenty-two watchstanders in the control and radio rooms, 13 of them periscope operators, evaluated low level white (LLW) lighting equated in brightness to that of the red light normally used. Twenty preferred the LLW, one had no preference, and only one watchstander, a radioman, gave it a low rating.

INTRODUCTION

Red light has traditionally been used to illuminate submarine control compartments at night. The reason is to facilitate subsequent dark adaptation when the ambient light is turned off. The advantages of red light have been exaggerated, however (Luria and Kobus, 1985). As the ambient light level decreases, the difference in the time required to dark adapt under red and white light also decreases. At the intensity level of the ambient light in the submarine at night, the time saved in dark adapting is less than about a minute, on the average. This does not seem to be of any operational significance. For this reason, we have recommended that white ambient light, equated in brightness to that of the present red light, be adopted.

We have previously shown (Kobus and Neri, 1984) that a majority of crewmen prefer the low level white (LLW) lighting to red — or to the blue which some dissatisfied crews substituted for red (CO, USS GREENLING, 1980). More important, we have demonstrated that there are no performance decrements under the LLW compared to red, either in ability to detect low contrast targets (Neri and Kinney, 1982) or in dark adapted performances through the periscope (Luria and Kobus, 1985).

Following these laboratory studies, several evaluations of the LLW at sea were carried out (Luria and Kobus, 1985; Kobus and Luria, 1985; Benson, et al, in preparation; Kobus and Luria, in preparation). The LLW has been enthusiastically received by the crews in these studies, but additional evaluations are desirable. This report gives the responses of the crew of the USS AUGUSTA (SSN 710) to the installation of LLW.

METHOD

LLW filters which produced white light equal in brightness to that of the red filters (Kinney, 1983) were installed in the control and radio rooms. For one week watchstanders filled out a questionnaire at the end of each watch under the LLW in which they evaluated the ease with which they could carry out their duties. A series of questions was prepared which gave particular attention to those tasks which the watchstanders considered most difficult. They were asked to rate the LLW on a scale of 1 to 5 for the ease with which it permitted their various tasks to be carried out. A total of 22 watchstanders participated in the evaluation; 13 were periscope operators.

RESULTS

Acceptability

The mean ratings for each of the questions are given in Table 1. A rating of 1 was the most satisfactory; a rating of 5 was the most unsatisfactory. In every case, the mean rating was on the satisfactory part of the scale.

The mean acceptability rating of the LLW across all the questions by all the watchstanders who participated in the survey was 1.86.

The crew were asked how easy it was to adapt to the LLW when the overhead lights were first dimmed and how easy to adapt to "black" when the ambient light was turned off. The mean ratings were 1.68 and 1.95, respectively.

Watchstanders are required, of course, to monitor controls and indicators and to read logs, charts, and various publications. The mean rating for the ability to do this under LLW was 1.82 for controls and dials and 2.38 for printed items.

Thirteen of the watchstanders use the periscope. They gave a mean rating of 2.0 for the ability to see through the periscope after being in LLW.

The comfort rating -- with regard to eye-strain and headaches -- was 2.09. The ability to move around under LLW was rated 1.6. The acceptability of having to stand an entire watch under LLW was 1.48.

TABLE 1

MEAN RATINGS FOR THE VARIOUS QUESTIONS

Ability to adapt to LLW from bright white light	1.68
Ability to adapt to black from LLW	1.95
Ability to see through periscope	2.00
Ability to read controls and indicators	1.82
Ability to read logs and charts	2.38
Comfort	2.09
Ability to move around	1.60
Desirability of LLW for entire watch	1.48
Mean rating	1.87

Problems

The watchstanders reported two problems. The men at the plotting tables felt that the LLW was not bright enough when the control room was rigged for black.

The light in the passageway outside the control room was considered to be too bright when the control room was rigged for black.

DISCUSSION

The LLW lighting was rated favorably on every aspect covered by the questionnaire. A particularly important question is whether or not this lighting is desirable for an entire watch. Only two of the watchstanders gave a negative response to this question, whereas 13 gave the LLW the highest rating.

Another problem of crucial importance is the ability to see through the periscope. None of the 13 periscope operators gave the LLW a negative rating; three gave the LLW the highest rating.

Twelve of the participants added their personal comments at the end of the questionnaire. Seven of these commended favorably on the LLW. Two of them, however, noted that the LLW in the periphery of the field of view was much brighter than red; thus when the door to the passageway was opened, the light outside the control room appeared unacceptably bright. This criticism was made in a previous evaluation (Luria and Kobus, 1985). For this reason, dimmer lights were installed in the passageway for the present evaluation. It appears, however, that still dimmer light may be necessary to eliminate the problem.

Another man noted that it was difficult to read certain labels on equipment in the radio room under LLW. One man remarked that the LLW was too dim, and the fifth man said that the LLW was uncomfortable.

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